Hayabusa—The First Asteroid Sample Return Mission

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Fig. 1. *The Hayabusa capsule is examined by the recovery team following reentry.*

When the Institute of Space and Astrological Science/Japan Aerospace Exploration Agency Hayabusa spacecraft parachuted into the Woomera Prohibited Area in South Australia on the evening of June 13, 2010, Johnson Space Center (JSC) scientists were there to meet it. The JSC participants were members of the science team of the Hayabusa mission, the first sample return mission to visit an asteroid and only the third sample return mission since the Apollo and Luna missions of the 1960s and 1970s. The JSC members helped coordinate ground-based observers of the atmospheric reentry fireball and served in the field on the capsule recovery team. The atmospheric reentry and landing of the spacecraft was flawless, and the capsule landed very near the center of the calculated landing ellipse—an astounding feat considering the difficulties in navigating the spacecraft and steering it into the atmosphere. Figure 1 shows the Hayabusa capsule, following reentry, under examination by the recovery team. The team was prepared to douse the spacecraft with spermicide liquid in the event the capsule had opened upon landing.

Those who have been following the mission know about the many nail-biting episodes in its flight both to and from asteroid Itokawa. But even after the safe landing back on Earth, the big question remained, "Would there be any samples inside?" The asteroid regolith sampling mechanism had failed, and all hopes centered on the possibility that stray regolith grains might have been captured during one or more of the spacecraft's forceful touch-and-go landings on the asteroid's surface. On recovery, the capsule was flown by chartered jet to a new curation laboratory at the Institute of Space And Astrological Science's Sagimihara campus for dissection.

It took weeks of work, but science team members found and removed thousands of asteroid regolith grains for detailed analysis. Every technique involved in sample removal, handling, and preliminary analyses were developed and optimized for these special samples, but the recent experience with the Stardust mission samples of comet Wild-2 were integral to the success with the Itokawa samples—all members of the Hayabusa sample analysis teams were previously involved in the Wild 2 samples. The JSC scientists—the only U.S. team members and leaders of the preliminary analysis of the Wild-2 samples in 2006—are participating in the preliminary Hayabusa analyses in Japan. At the March 2011 Lunar and Planetary Science Conference, the Hayabusa preliminary analysis teams reported the first results to packed crowds of planetary scientists. Figure 2, an excerpt from the initial reporting, is an electron backscattered image of one asteroid Itokawa grain.

After completion of the preliminary analysis, the Itokawa samples will be made available to investigators worldwide. At this time, 10% of the recovered samples will be permanently transferred to JSC, where they will be housed in a new Hayabusa Curation Laboratory, just down the hall from the comet Wild-2 samples. Together, these samples will drive new efforts into understanding the origin and early history of the solar system.

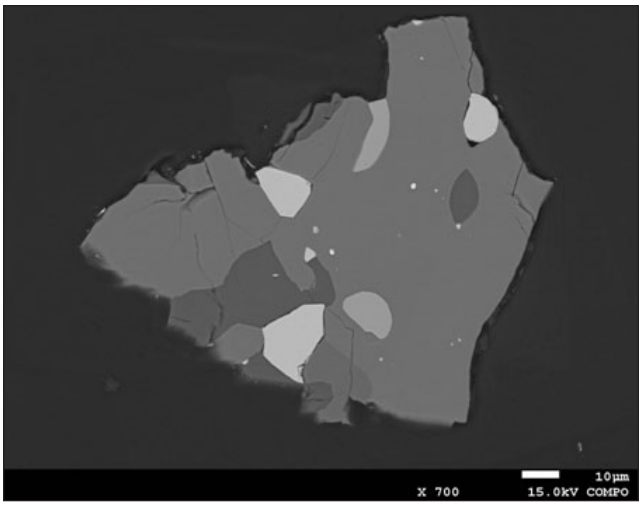

Fig. 2. *An electron backscattered image of one asteroid Itokawa grain. Bright areas are sulfide and oxide crystals, grey regions are silicates. Scale bar is 10 micrometers.*